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AUTHOR Starr, Harold
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ABSTRACT

This study was conducted to determine how state and local vocational education has responded to shortages of industrially oriented skilled craftsworkers and technicians since the mid-1970's. The findings are intended to serve as a basis for suggestions of ways to enhance responsiveness in the 1980's and beyond. The six information sources analyzed included literature such as reports and journals, congressional testimony, state plans for vocational education for 1978, annual vocational education programs from 1974-75 through 1978-79, and publications issued by state employment services. The major findings of the study were the following: (1) a shortage of skilled industrial workers in the 1980's and beyond may exist; (2) information systems cannot yet predict labor shortages or their locations; (3) local providers of vocational education have been responding to occupational skill shortages in their areas; and (4) state vocational education agencies have created many short-term customized training programs, but little long-range planning has occurred. As a result of these findings, it was suggested that Congress should consider providing a framework for vocational education and business/industry groups to create job training partnerships and funding information systems to forecast skill shortages at every level. It was also suggested that state boards and vocational education agencies should consider long-range planning for job training to encourage articulation between secondary and postsecondary vocational education and to include more varied data in planning. (KC)

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VOCATIONAL EDUCATION'S RESPONSE TO SKILLED INDUSTRIAL WORKER SHORTAGES

Harold Starr

U.S. DEPARTMENT OF EDUCATION
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1960 Kenny Road
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FOREWORD

There is a pervasive concern that national priorities for reindustrialization and defense preparedness could be adversely affected by serious shortages of adequately trained skilled industrial craftsworkers and technicians. This report examines how public vocational education has been responding since the mid-1970s to skilled industrial worker shortages. The findings provide a basis for recommending ways of improving the responsiveness of vocational education to such skill shortages in the next decade.

The National Center is indebted to Harold Starr, Harold Merz, and Gale Zahniser, who served as project staff. Harold Starr, the project director, produced the report. He is a Senior Research Specialist and Program Director (Comprehensive Planning) in the Evaluation and Policy Division of the National Center. Harold Merz and Gale Zahniser are Program Associates at the National Center and were responsible for collecting, reviewing, and reporting findings from relevant literature, state plans and annual program plans for vocational education, and documents supplied by state employment services agencies.

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Robert E. Taylor
Executive Director
The National Center for Research
in Vocational Education

EXECUTIVE SUMMARY

Concerns about the state and fate of the nation's industrial base and defense preparedness in the 1980s and beyond have stimulated a national interest in skilled worker shortages and the ability of training agencies to supply skilled workers with pertinent training. This study was conducted to determine how state and local vocational education has responded to shortages of industrially oriented skilled craftsworkers and technicians since the mid-1970s. The findings serve as a basis for suggestions of ways that policymakers and vocational education administrators can improve that responsiveness in the 1980s and beyond.

Six information sources were analyzed: (1) relevant literature from reports, journals, and other sources; (2) testimony before Congressional committees by representatives of a number of trade and professional associations; (3) state plans for vocational education prepared in 1978; (4) annual vocational education program plans for fiscal years 1979, 1980, and 1981; (5) national enrollment data in vocational education programs for school years 1974-75 through 1978-79; and (6) publications issued by state employment services agencies that were made available to state boards and agencies for vocational education for use in program planning.

The literature and congressional testimony pointed up a widespread consensus that, aside from the effects of the present recession, skilled workers in a number of industrially oriented occupations are not available for employment when and where they are needed, and that such skill shortages are likely to increase in the future. Several factors account for this situation, including: (1) demographic trends indicating that fewer younger workers will be entering the work force; (2) the trend in employment away from production and toward the service industries and occupations; and (3) the likelihood that economic recovery will be accompanied by industrial expansion.

Findings

The major findings of the study can be summarized as follow:

- There is insufficient data to be certain that there will be shortages of skilled industrial workers in the 1980s and beyond. There are logical reasons for supposing that such shortages are likely.

- Information systems are not yet in place that can adequately estimate labor shortages, their extent, or locations.

- Local providers of vocational education have a record of responding to occupational skill shortages that are known to exist or are likely to exist in their service areas.

- There are many examples of short-term customized training programs for industrial craftsworkers and technicians that have been initiated and/or supported by state vocational education agencies. However, few of these agencies have given a visible priority to long term planning and policy formulation to deal with skilled labor shortages.

Implications of the Findings

These findings serve as a basis for suggesting that Congress should consider--

- providing a framework for state and local vocational education and business and industry groups to create ans sustain job training partnership arrangements that will actively involve employers in vocational education planning to meet skilled labor shortages. Local and state advisory councils for vocational education are not a sustitute for job training partnership arrangements.

- encouraging and adequately funding the development of information systems that can forecast (even if imprecisely) occupational skill shortages and surpluses at state, regional, and national levels. The Bureau of Labor Statistics, the National Occupational Information Coordinating Committee and its state counterparts, and state and local vocational education agencies should be involved in achieving this aim.

State boards and agencies for vocational education should consider--

- formulating the kinds of long-range planning and funding policies that do not shortchange the long-term, expensive training that is required to produce skilled industrial workers who will be adaptable to the occupational skills required in the next decade. There are, for example, conflicts in many states over allocating available funds for supporting secondary and postsecondary vocational education. Given the length of time needed to educate as well as train persons adequately to be craftsworkers or technicians, more attention should be directed to how best

to articulate secondary and postsecondary vocational education and not how to divide up available funds between the two deliverers;

- including data on demographic trends, forecasts of industrial expansion, and analyses of emerging technologies in industrial production in doing program planning to deal with skilled labor shortages.

CHAPTER I

INTRODUCTION

Recent concerns about the state and fate of the nation's industrial base and defense preparedness in the 1980s and beyond have stimulated a national interest in skilled worker shortages and the ability of training agencies to supply skilled workers with pertinent training. Much testimony has been presented before Congress to the effect that: (1) shortages of skilled workers in industrially oriented occupations are having--or will have--an adverse effect in coming years on output in both the civilian and domestic defense industry sectors of the economy; and (2) these effects will likely be intensified in the future unless appropriate training programs are implemented or expanded, especially at the postsecondary and university levels (U.S. House 1980, 1982; U.S. Congress 1982; American Electronics Association).

Most of the testimony centered around a small group of occupations that are believed to be experiencing growing shortages of skilled workers. These occupations can be characterized as requiring relatively long training periods, as well as skills and aptitudes not widely distributed in the population. Testimony also revealed that shortages of skilled workers are not easily relieved by raising wages. Furthermore, shortages of workers in these occupations can be expected to affect adversely the nation's output of basic products and services, as opposed to having strictly local consequences (Ruff et al. 1981).

Skill shortage occupations described in congressional testimony included the skilled machining trades, electrical and electronics engineer, electronics technician, and computer scientist. Concern in this testimony was also expressed for the need for upgrading skilled workers in light of new technologies and production techniques. It was also indicated that if significant industrial recovery and expanded contracting in the defense industry occur rapidly, shortages of skilled workers in a wide range of industrially oriented craft and technical occupations could occur.

There are several reasons for assuming that shortages of skilled workers will be with us in the future. First, the United States labor force is expected to increase anywhere from 17 to 25 percent between 1980 and 1990 (Pilot 1982, p. 46). Accompanying an evident need for new workers will be a decline in the United States birthrate which will result in fewer younger workers available to enter the work force (Flaim and Fullerton 1979).

Second, industry's need to become more profitable and competitive has caused--and may continue to influence--production oriented firms to relocate, whereas other plants may shut down or reduce their skilled labor requirements in the face of unfavorable economic conditions. New employment opportunities for unemployed skilled workers may exist at some distance from where the workers reside, but many of them find it too difficult to relocate to new job sites. The result is that the number of skilled workers remains the same, but the workers are not necessarily available for employment where and when they are needed.* This last situation is one factor that has prompted the majority of states to involve their state vocational education agencies in delivering customized training programs to meet skill training needs of specific firms (Bottoms 1982; Brant 1982; Burdette 1982).

Third, there are likely to be shortages in certain skilled occupations if the recent trend in employment away from production and toward the service industries and occupations continues. Fourth, a strong economic recovery accompanied by industrial expansion and modernization may create short-term imbalances in the supply and demand for skilled workers, and may create a need for expanded training initiatives to prepare new skilled workers and to upgrade the skills of existing workers.

The current administration in Washington proposes to increase defense expenditures substantially. If the Congress goes along with the administration's requests, the bulk of increased defense expenditures is likely to go to the development and production of defense goods and services by the defense industrial base of the nation (Personick 1981). In response to the probable impact these expenditures will have on the defense industrial base, the U.S. Department of Defense has commissioned a study to explore the consequences of alternative defense spending scenarios on key industrial sectors and demands for skilled labor (Blond 1981; Brown and Doggett 1981). This study suggests that the needs of the defense industrial base for skilled labor are likely to be met. However, the achievement of this objective can be expected to have uncertain implications for the supply of skilled workers in nondefense industries, as well as for education and training programs. As Brown and Doggett (1981) point out:

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*The large number of skilled workers who are permanently dislocated as a result of plant closings and relocations will only be partially aided by implementation of Title III of the recently enacted Job Training Partnership Act of 1982. Title III deals with retraining and provides for a limited relocation program for affected workers.

> In virtually all circumstances, the defense components of output and employment should be able to be met if effective management exists to transfer resources and broaden the base within industry and occupational groups which can be targeted to the defense component of overall demand. To achieve this same objective without impacting on non-defense output, however, will require that significant increases in employment within particular industries and occupational groups be achieved, often implying the need to bring additional skilled and trained personnel into the base. These requirements are most frequently noted in the skilled blue collar labor categories. Meeting such a requirement will imply a reversal of the recent trends in employment away from production towards the service industries and occupations. The implications of expanding theemployment base of production workers extend in important ways into the educational and training programs operating within the nation. Like the capital investment requirements implied by the higher defense spending plans, this transition involves many uncertainties and will certainly require the attention of planners and managers in both government and the private sector. (p. 19)

Purpose and Direction of the Study

The study reported herein was conducted to determine how state and local vocational education agencies and institutions have responded to presumed shortages of skilled industrially oriented skilled craftsworkers and technicians since the mid-1970s. These insights were then to serve as a basis for suggesting ways of improving that responsiveness in the 1980s and beyond.

To arrive at these insights, the issue of shortages of skilled workers was examined, along with indicators of the responsiveness of vocational education since the mid-1970s in providing the kinds of training needed to meet these shortages. Implications of the findings and suggestions for improving the level of responsiveness of state and local vocational education are presented in later sections of this report for consideration by policymakers and vocational education administrators.

Approach and Limitations of the Findings

The provision of vocational education is based on a state-local partnership. This report examines the contribution of each partner in responding to shortages of skilled industrial workers.

Local schools initiate programs and provide opportunities for training. They respond to local employers' needs and students' interests. State vocational education agencies, on the other hand, have an interest in seeing that the aggregate of local programs are responsive to broader statewide economic and social needs. State agencies respond by acquiring an awareness of training needs, prioritizing these needs, informing local providers of the broader state needs, and collaborating with them to achieve a balance between these state needs and local training concerns. An analysis of the responsiveness of vocational education to any training issue therefore requires an examination of the contribution of each partner.

The strategy used in this study was to examine extant data bases. Limitations in time and resources prevented the inclusion of other techniques (e.g., use of questionnaires, on-site data collection, interviews) for determining the responsiveness of vocational education to skilled labor shortages. The findings presented in this report are, therefore, limited by the technique used to analyze the responsiveness of vocational education, as well as by any inherent limitations in the particular data bases selected for analysis purposes.

Because of present economic circumstances, there are now large numbers of unemployed industrially oriented skilled craftsworkers and technicians. This report assumes that this situation is a temporary one and that shortages of such workers will prevail in the 1980s and beyond for reasons mentioned elsewhere in this report.

CHAPTER II

VOCATIONAL EDUCATION'S RESPONSIVENESS

What Occupations Qualify for Analysis?

A search of the literature was performed to verify the existence and extent of skilled industrial worker shortages since the mid-1970s and to ascertain if such shortages are likely to exist in the coming decade. It soon became obvious that quantitative estimates of skilled worker shortages do not exist. Thus, it was decided to include a range of industrially oriented skilled craftsworker and technician occupations in the analysis of vocational education's responsiveness, and to give special focus to those occupations for which documentation of shortages was most convincing.

The most adequately documented shortages seem to be in the skilled machining trades. Since any shortages in the skilled machining trades are likely to affect reindustrialization and military preparedness, this group of occupations will receive a special emphasis in the analysis that follows. Then, evidence will be presented to support the assertion that skilled machining trades have indeed been experiencing severe shortages of skilled workers, and that these shortages are likely to continue.

Skilled Machining Trades

Industry groups, such as the Task Force on Skilled Trades Shortages (1981) and The National Tooling and Machining Association (1982), as well as authors in trade journals such as Chilton's Iron Age (Bowers 1977; Barks 1979; Greene 1980) and staff of the Department of Labor (Kutscher 1982; Rosenthal 1982) all concur that national skill shortages in the skilled machining trades are real, even if the extent of the shortages is not presently quantifiable.

The Task Force on Skilled Trades Shortages is a coalition of trade organizations representing thirty-two thousand plants employing 1 million persons nationwide. According to a recent publication of the Task Force (1981), their membership is troubled by "the critical shortage of skilled workers in mold making, tool making, precision machining and other specialized metal working positions" (p. 1). Although unable to substantiate the full scope of such shortages, the Task Force believes that "available figures show a serious imbalance between job openings and qualified prospects available to fill positions" (p. 2).

A more evidence-based argument for presuming that critical national skill shortages exist in the skilled machining trades has been made by the National Tooling and Machining Association (1982). This association is composed of thirty-seven hundred member companies comprising about one-fourth of the approximately fourteen thousand American companies in the machining trades job shop industry. The National Tooling and Machining Association recently undertook a survey of its membership to document the extent of skilled labor shortages among its members. The Association reports that:

> The typical respondent said that an additional 2.3 journeymen would be hired immediately (under current business conditions) if available, and that a total of 5.3 additional journeymen would be hired if available under ideal business conditions (at present levels of plant and equipment). . . . This represented a desire of these firms to expand their journeyman workforce by 50 percent. (pp. 8-9)

The Association further cautions that it is "highly unlikely that even if 32,000 journeymen suddenly became available to work in job shops (member and non-member) that the work force would grow by that number" (p. 10).

Recognizing that there are problems with studies designed to quantify the extent of skill shortages in the skilled machining trades, the National Tooling and Machining Association (1982) also provides five kinds of empirical evidence that indicates that shortages of skilled machining trades workers are critical national ones in the sense used in this paper.

- Extended lead times for deliveries of most engineered products.
- Classified newspaper employment advertisements in most industrial cities in the U.S. still show demand for these workers, despite a sluggish economy.
- Wage rates for some individuals in these trades exceed $20/hour in some parts of the country.
- Journeyman-level workers in these trades usually have plenty of opportunity for overtime, and 50-hour weeks are not unusual, even in relatively slow periods.
- Employment agencies have sprung up which specialize in recruiting skilled machining tradesworkers from outside the U.S. and some employers make regular trips abroad to recruit skilled machinists, toolmakers, diemakers, modelmakers and other specialists that aren't available at home (ibid., p.2).

The findings of Kutscher (1982) and Rosenthal (1982) lend further substantiation for the belief that critical national skill shortages exist in the skilled machining trades. Kutscher summarizes the extent of shortages of job and die setters, tool and die makers, machinists (skilled occupations), and machine operators (skilled and semiskilled occupations) in this way:

> Only in the skilled category was there an appreciable increase in employment throughout the past decade. . . . Information about the job market for skilled machining workers during the 1970s is consistent with the existence of shortages. . . . However, statistics generated by ongoing data collection programs do not provide information necessary to quantify the shortage . . . the severity of the shortages varies among geographical areas. (Kutscher 1982, pp. 11, 13)

Taking all available information about the extent of shortages in skilled machining occupations into consideration, Rosenthal concludes:

> During the past few years many articles dealing with current and expected future shortages of machinists were published in national periodicals. Their basic conclusions were generally consistent: Employers currently are not able to hire as many skilled machinists as they would like; current training is not sufficient to alleviate shortages; and similar conditions have existed for some time. Concern about the future supply is also based on the expected decline in the number of 18 to 24-year-old workers in the 1980s. However, different conclusions result from studies concerning technological change. They generally state that the need for manual labor in factories, especially highly skilled machinists, will be reduced significantly in the future.
>
> Because of the different viewpoints of these studies, future supply-demand conditions for machinists are unclear. Furthermore, very little of the statistical information used to present both sides is based on "hard data." (Rosenthal 1982, p. 31)

Rosenthal uses data on wages and unemployment to support the idea that there is a real shortage of skilled machining trades workers. He notes that between 1972 and 1980, offering high wages to attract more such trades workers did not overcome the skilled labor needs of employers:

> Workers in the machining occupations covered in the BLS Area Wage Surveys had higher, average hourly earnings than all production workers in the manufacturing industries in the same city as reported in the Bureau's current Employment Statistics program. (ibid., p.33)

Rosenthal also presents evidence indicating that unemployment rates for machinists and tool and die makers were lower than those for craftsworkers as a whole in each year from 1972 to 1980.

Surprisingly, similar documentation could not be found to support the existence of skill shortages in other industrially oriented skilled craft or technician occupations. However, although it is not as well documented, there is a data-based case to be made for shortages of electrical engineers and electronic technicians (American Electronics Association 1981). But for purposes of this study, electrical engineers do not qualify for analysis, since this occupation requires at least a college degree.

There are many difficulties associated with quantifying and forecasting skilled industrial labor shortages. Not the least of these difficulties is the fact that there is a gap in our understanding of how changing production technologies may require skilled workers to learn new skills if they are to remain adequately productive.* Another difficulty is in identifying the potential workers who not only want to be trained in the pertinent skilled occupations, but who also have the literacy and computational skills needed to adapt to changing occupational requirements.

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*See Michael J. Piore (1981) for a discussion of how increasing trends toward batch production as opposed to mass production computer-based technologies are likely to create a need for more highly skilled craftspersons.

CHAPTER III

FINDINGS

In assessing the responsiveness of vocational education to shortages of industrially oriented skilled craftsworkers and technicians since the mid-1970s, several lines of evidence were pursued. First, long-range state plans and annual program plans for vocational education were examined to determine what policy and program planning initiatives the state-level vocational education agencies had in place with respect to shortages of industrially oriented skilled labor. The employment data provided to state vocational education agencies by their state employment services agencies were also examined to determine whether the employment services agencies had sensitized their state vocational education agencies to the existence of industrially oriented skilled labor shortages. Second, national vocational education enrollment data were analyzed to determine whether students' demands for training opportunities--which often reflect changing opportunities for employment--were responded to by local providers of vocational education. In this instance, analysis was limited by the fact that the data used were not recent but were the best available.

State Plans for Vocational Education

State plans for vocational education were considered as a logical source of information on the intentions of state vocational education boards and agencies to respond to shortages of skilled workers (at least in 1978). State plans represent assessments by state vocational education boards and agencies of state employment needs, as well as the boards' and agencies' intentions to meet the identified employment needs through planning and policy initiatives. State plans for vocational education also reveal where state vocational education agencies obtain their information on shortages of skilled workers.

State plans for vocational education from the fifty states and the Commonwealth of Puerto Rico were included in the assessment process. These plans, as required by the Education Amendments of 1976 and the accompanying Rules and Regulations for Vocational Education State Programs and Commissioner's Discretionary Programs, were first prepared in 1978.

The Amendments and the Rules and Regulations direct the state boards for vocational education or their designated agency (the state vocational education agency) to use funds available to it to support instructional programs that are consistent with

available employment opportunities. To achieve this objective, the states are directed to use the latest and most accurate employment data to assess current and future needs for workers and job skills within the state and--where appropriate--the pertinent region of the country. These employment data are to be used by the individual state vocational education boards to help formulate long-range and annual program and enrollment goals for the state's vocational education system. The state plans are also to describe how funds will be allocated to meet identified employment needs, as well as describe the reasons for making the funding decisions.

The contents of the state plans were examined with particular attention given to determining whether states used information on shortages of skilled machining trades workers and/or other kinds of skilled labor in developing the rationale for program goals. If skilled labor shortages were described in state plans, the plans were studied to determine whether there were specific planning and policy initiatives to ensure that those employment needs would be met.*

There was a noticeable absence in the state plans that were researched of specific references to skilled labor shortages as a basis for formulating program goals. In thirty-one of the state plans, it was not possible to determine a clear relationship among program and enrollment goals, funding decisions, and employment needs. There was such a relationship in twelve state plans, but it was based on estimated needs for workers resulting from occupational growth requirements and not because of estimated shortages in the supply of skilled workers to fill job openings. In these cases, employment needs were assessed without balancing "demand" with "supply" considerations. In the remaining eight state plans, estimates of the net employment demand less the projected net employment supply of institutionally trained workers for various occupations was used to support a relationship among program and enrollment goals, funding decisions, and employment needs.

The eight states that used trained worker supply estimates came closest to relating their programming and allocation decisions to actual or potential skill shortages. But even there,

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*State plans are complex documents. As a result, project staff may, in a few instances, have overlooked comments indicating that a state agency identified or addressed skill shortages; or the contents may have failed to communicate the actual state of affairs. Even if this is the case, however, the essential findings would not be altered. This caveat also holds true for the annual program plans and published employment data that have been examined.

the relationship was not always a clear one. The plans of these eight states did not describe the relative magnitude of any supply-demand imbalances for skilled labor, the potential impacts of such shortages, or the relative contribution of noninstitutionally trained persons to the estimate of the labor supply available to meet employers' needs.

In none of the state plans were skilled machining trades or other occupations experiencing shortages of skilled workers identified or prioritized as such. It follows that since shortages of skilled workers in occupations were not identified in the state plans reviewed, there were no descriptions of planning and policy initiatives to deal with such shortages.

States did comply with federal requirements by approving local applications for federal funds for individual programs only if local applicants could show local employment opportunities or if the best employment data available at the state level justified offering the program. The problem with using this best available employment data at the state level is that it has usually consisted of employment growth projections rather than supply-demand gaps. Certainly one cannot fault state vocational education agencies for using the data available to them as best they could. Local schools, on the other hand, could be responsive to local labor needs by addressing some employers' needs, but might or might not specifically address needs for industrially oriented craftsworkers and technicians, even if such needs exist.

Annual Program Plans for Vocational Education

Annual program plans for vocational education from the fifty states and the Commonwealth of Puerto Rico for fiscal years 1979, 1980, and 1981 were also included as part of the document base. However, only a few 1981 annual program plans were available for review, as most of these plans had not been released for distribution by the states at the time of the document base analysis.

Under the provisions for annual program plans in the Education Amendments of 1976, the states are required to modify the assessment of employment needs reported in the state plan for vocational education if later or more accurate employment data have been made available to the state vocational education boards or their designated administrative agencies. If the original assessment of employment needs is modified, then the states are required to modify their original program and enrollment goals accordingly.

The contents of the annual program plans were examined and, as in the case of state plans, particular attention was given to determining how many states emphasized skilled labor shortages. Again, efforts were made to determine whether specific planning and policy initiatives were described to deal with identified skilled labor shortages. Finally, whenever annual plans described skilled labor shortages, the sources of information about the shortages were identified and recorded.

The identification of skilled labor shortages was found in one or more of the annual program plans of seven states. In five of the seven states (New Hampshire, Oklahoma, South Carolina, Tennessee, and Vermont), shortages of skilled machining trades workers were reported in one or more annual program plans. Three of these five states also reported other kinds of skilled labor shortages (i.e., other kinds of craftsworkers, technicians, and nursing and allied health workers). Two other states, Massachusetts and Mississippi, identified skilled labor shortages in nonmachining trades occupations. Kansas--the eighth state--identified a shortage of nonskilled workers in one or more of its annual program plans.

The seven state boards and agencies for vocational education responded to identified skilled labor shortages in at least two ways: (1) informing local applicants for federal vocational education funds that programs intended to prepare persons for such shortage occupations would in some way be given a preference in the program approval and allocation processes of the state, and (2) indicating that local applicants should consider shortage occupations in planning local vocational education programs.

Of the five states indicating worker shortages in the skilled machining trades occupations, two of them--Oklahoma and South Carolina--reported that these shortages were identified by one or more local offices of the state employment services agency. Tennessee identified its information sources on skilled labor shortages as employer groups. Vermont and New Hampshire did not list the sources of their information about skilled labor shortages. Interestingly, the reported sources of information about skilled labor shortages never included the state advisory councils for vocational education, the state planning groups, or the State Occupational Information Coordinating Committee. This suggests that it may be desirable to include labor and industrial employer representation in the membership or activities of these groups.

The results of the examination of annual program plans are summarized in table 1.

TABLE 1

TYPES OF SKILL SHORTAGES AS REPORTED IN ANNUAL PROGRAM PLANS

SOURCE State Plan/ Annual Program Plan	TYPES OF SKILL SHORTAGE					SOURCES OF INFORMATION ABOUT SKILL SHORTAGES			
	Machining Trades	Other Crafts-workers	Technicians	Nursing, Allied Health	Other Occupations (nonskilled)	Local Office of State Employment Services Agency	Employer Group	Other Source	Not Indicated
Kansas					●	●			
Massachusetts			●				●		
Mississippi				●					●
New Hampshire	●		●						●
Oklahoma	●				●	●			
S. Carolina	●	●	●	●		●			
Tennessee	●	●	●				●		
Vermont	●			●					●

Published Employment Data

Employment data publications prepared by state employment services agencies and made available to state vocational education agencies represent "official" information about skilled labor shortages. It was the intent of Congress, in its enactment of the Educational Amendments of 1976, that state vocational education boards and agencies should secure the latest and most accurate employment data available for use in preparing state plans and annual program plans for vocational education. Congress expected each state board and agency to secure such employment data from the state employment services agency, the U.S. Department of Labor, and the National Occupational Information Coordinating Committee. Since the Educational Amendments of 1976 emphasize that state vocational education boards should consider state (and where appropriate, regional) employment needs, state employment services agencies become the most logical "official" source of employment data for state vocational education planning purposes. In examining the data publications that state employment services agencies have made available to state vocational education agencies, an effort was made to determine whether these publications emphasized the existence of shortages of skilled workers, and if so, in what occupations.

Published employment information was obtained from forty-nine state employment services agencies. An examination of these publications has revealed that six state employment services agencies explicitly identified employers' needs for skilled

workers by occupations. These agencies were in the states of Georgia, Indiana, North Carolina, Ohio, Texas, and Wisconsin. All of these states (except Texas) indicated shortages of skilled machining trades workers. All six state employment services agencies indicated shortages of skilled nursing and allied health workers. Four of the six (Indiana, North Carolina, Ohio, and Wisconsin) indicated shortages of industrially oriented technicians. Two of the six (Indiana and North Carolina) indicated shortages in skilled craft occupations other than the skilled machining trades. The findings of the review of state employment services agency publications are summarized in table 2.

TABLE 2

TYPES OF SKILL SHORTAGES AS REPORTED BY STATE EMPLOYMENT SERVICES AGENCIES

SOURCE State Employment Services Agency	TYPES OF SKILL SHORTAGE				
	Machining Trades	Other Craftsworkers	Technicians	Nursing, Allied Health	Other Occupations
Georgia	●			●	●
Indiana	●	●	●	●	●
N. Carolina	●	●	●	●	●
Ohio	●		●	●	
Texas				●	
Wisconsin	●		●	●	●

It is interesting to note that labor shortages in the skilled machining trades occupations were not reported in the state plans, annual program plans, or state employment services agency publications of many of the large industrial states where such shortages might be expected to exist.

National Vocational Education Enrollment Data

Postsecondary-level enrollment trends were used as a quantitative indicator of vocational education's responsiveness

to skilled labor shortages.* Postsecondary-level program completion, placement, and follow-up trends would be more satisfactory indicators. However, nationally available data for the school years that were used in the analysis did not separate postsecondary-level completions from those at the secondary-level.**

The state plans and annual program plans that were examined span the time period of 1978 through early 1982. Although it would have been desirable to secure and examine enrollment data that spanned the same time period, this was not possible and compromise was necessary.

Postsecondary vocational education enrollment data for school years 1974-75 through 1978-79 were used in the assessment process. National enrollment data for the 1979-80 and 1980-81 school years were not available. For the four school years of 1974-75 through 1977-78, the states reported program, enrollment, and fiscal data using essentially the same format, instructional program codes, and directions for completing reports for transmission to the U.S. Office of Education. Although program and enrollment data are available for earlier years, a somewhat different coding system was used to identify instructional programs. Also, the coding system in effect for the school years prior to 1974-75 did not account for some of the occupations of concern here.

The school year 1977-78 represents the last year in which vocational education program and enrollment data were collected from the states under the direction of the U.S. Office of Education. Beginning in the school year 1978-79, the responsibility for collecting program and enrollment data was shifted to the National Center for Education Statistics, as mandated by the Education Amendments of 1976. The Amendments also established a new system for states to report program and enrollment data to the federal government. This system is the Vocational Education Data and Reporting System (VEDS). The first reporting of programs and enrollments under VEDS occurred in 1979. However, definitions of instructional programs, enrollments, and completions were not consistent with the reporting system in place prior to VEDS.

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*National vocational education enrollment and completion data represent imprecise data. Unfortunately, the degree of imprecision for individual programs (and consequently for national totals) and for different years is unknown. Consequently, the findings presented in this report that are derived from national enrollment should be examined with this caveat in mind.

**Secondary-level data were not used in the analysis and assessment. The skilled worker shortages discussed in this report by definition imply a level of skills training that is typically acquired at the postsecondary-level.

For purposes of analyzing trends and making comparisons of enrollments in vocational education instructional programs, two sets of enrollment data were used. The first set of enrollment data was for school years 1974-75 through 1977-78. The second set of enrollment data included the first year of data (school year 1978-79) reported under VEDS.

Information reported for each year in the first set of enrollment data (school years 1974-75 through 1977-78) was directly comparable because the reports used the same set of instructions, codes, and the like. However, these data did not span any of the years covered by the state plans and annual program plans. The 1978-79 VEDS data did at least help in this regard (although, as already mentioned, the VEDS coding structure, definitions, and so forth differed from the preceding reporting system). Thus, neither of the two sets of enrollment data used to analyze and compare enrollment trends in vocational education programs is considered ideal. The findings that are reported below about enrollment trends in vocational education are essentially the same regardless of which of the two sets of enrollment data are used for analysis purposes.

Responsiveness to Machining Trades Skill Shortages

The list of instructional program titles and codes for reporting vocational education enrollments contains three titles and codes that are used to report enrollments of persons preparing to qualify themselves or to upgrade their existing skills in the machining trades. These three titles and codes are: Machine Shop (17.2302), Machine Tool Operation (17.2303), and Tool and Die Making (17.2307).

Two of these programs, Machine Shop and Machine Tool Operation, are not occupationally specific. Also, one cannot be certain about the skill level of the training offered in these programs. In order to use the national enrollment data that are available for these two programs, it is assumed that some unknown but relatively stable proportion of the Machine Shop and Machine Tool Operation programs is devoted to the training of skilled machining trades workers.

Postsecondary, adult, and apprenticeship enrollments were combined to represent a single postsecondary enrollment count. Postsecondary, adult, and apprenticeship enrollments were combined because (1) there is no way to differentiate the program content, skill levels of training, or duration of training within or between the programs offered at the postsecondary and adult levels and through apprenticeship-related training; and (2) apprenticeship data were sometimes reported separately and sometimes not.

Figures 1 through 4 depict various comparisons among rates of growth in program enrollments between 1974-75 and 1977-78 (data set 1). An examination of figures 1 through 4 reveals that the rate of growth in enrollments for the three machining trades-related programs was--

- o slightly greater than for other industrially oriented trade and industrial education programs, and slightly more than double the rate for nonindustrially oriented trade and industrial education programs;
- o more than four times greater than for industrially oriented technical education programs;
- o equal to that of the health occupations program field; and
- o substantially greater than the growth rates in enrollments for office education, distributive education, agricultural education, and consumer and homemaking education (occupational preparation) program fields.

Comparison of the rates of growth in postsecondary enrollments depicted in figures 1 through 4 suggests that local postsecondary vocational education agencies and institutions did, by design or because of clients' interests, respond to the need for skilled machining trades workers. They did so at a rate of growth in enrollment that equaled or exceeded most other fields of vocational education.

Figures 5 through 8 reflect rates of growth in postsecondary enrollments for school years 1974-75 through 1978-79 (data set 2). An examination of figures 5 through 8 reveals that the rate of growth for the three skilled machining trades-related programs exceeded the rates of growth for all nine groups of programs and fields with which it was compared. Thus, these enrollment data findings are consistent with the findings for data set 1 (figures 1 through 4).

Other interesting statistics were derived from an examination of enrollment data for machine shop, machine tool operations, and tool and die making programs. The postsecondary enrollment count in these three programs for the period 1974-75 through 1978-79 was 350,854 persons, or an average of 70,171 persons per year. The largest postsecondary enrollment in these three programs was in school year 1978-79, when enrollment reached 77,055.

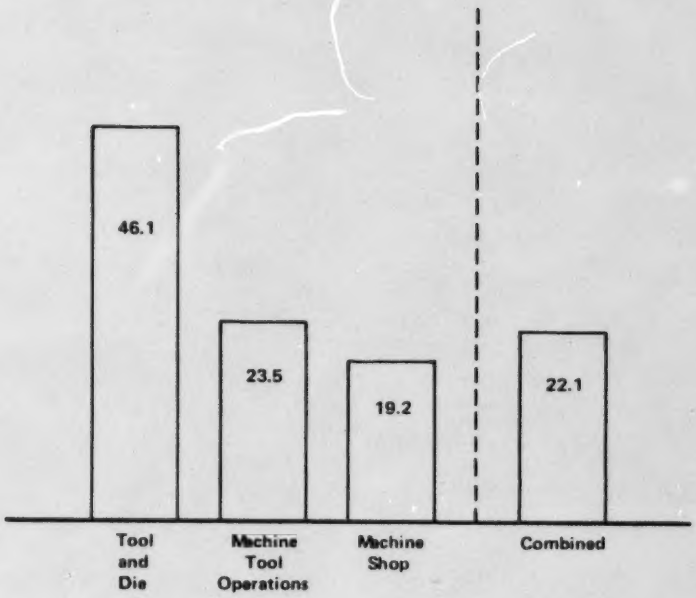

Figure 1. Comparative rates of growth for 1974-1975 -- 1977-1978 in machining trades-related programs

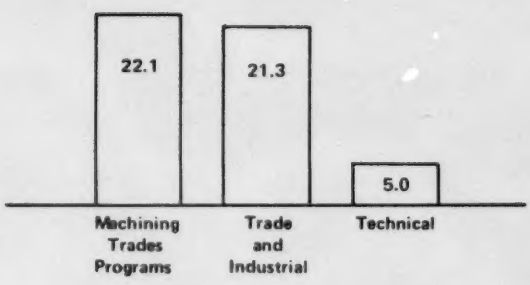

Figure 2. Comparative rates of growth for 1974-1975 -- 1977-1978 in industrially oriented programs

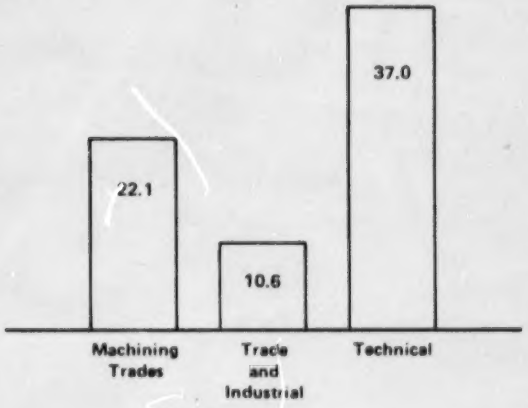

Figure 3. Comparative rates of growth for 1974-1975 -- 1977-1978 in nonindustrially oriented programs

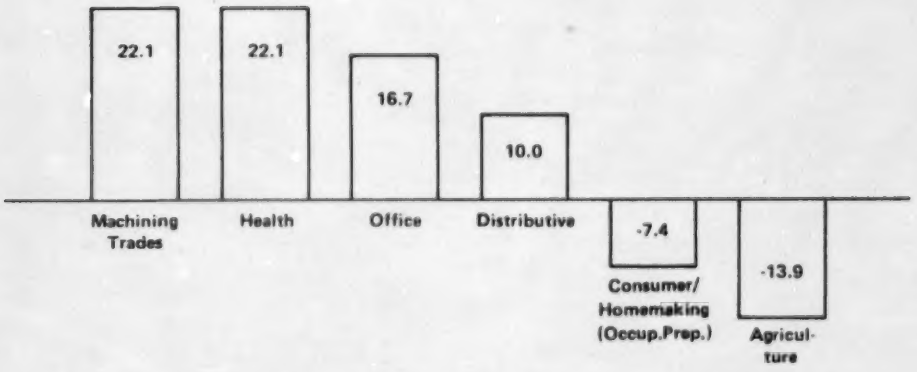

Figure 4. Comparative rates of growth for 1974-1975 -- 1977-1978 in vocational education programs/fields

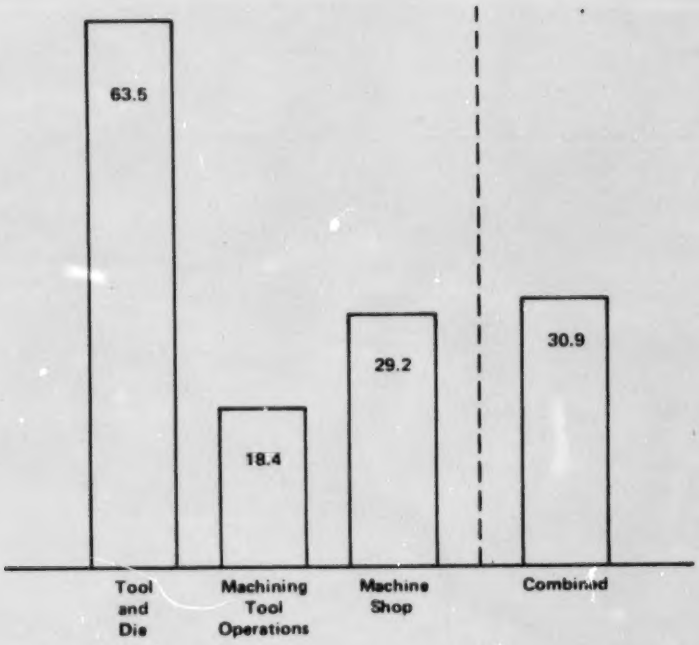

Figure 5. Comparative rates of growth for 1974-1975 – 1978-1979 in machining trades-related programs

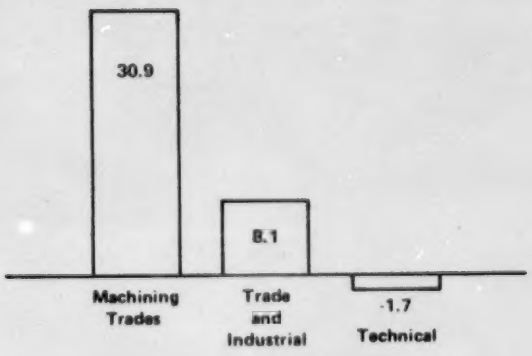

Figure 6. Comparative rates of growth for 1974-1975 – 1978-1979 in industrially oriented programs

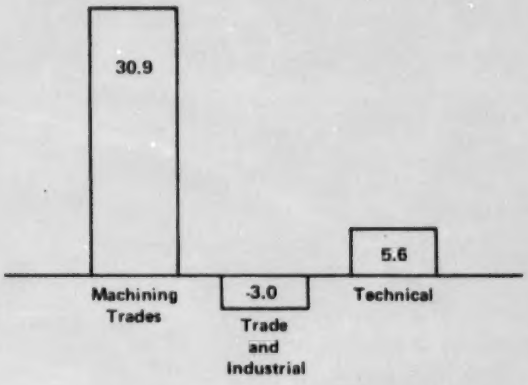

Figure 7. Comparative rates of growth for 1974-1975 -- 1978-1979 in nonindustrially oriented programs

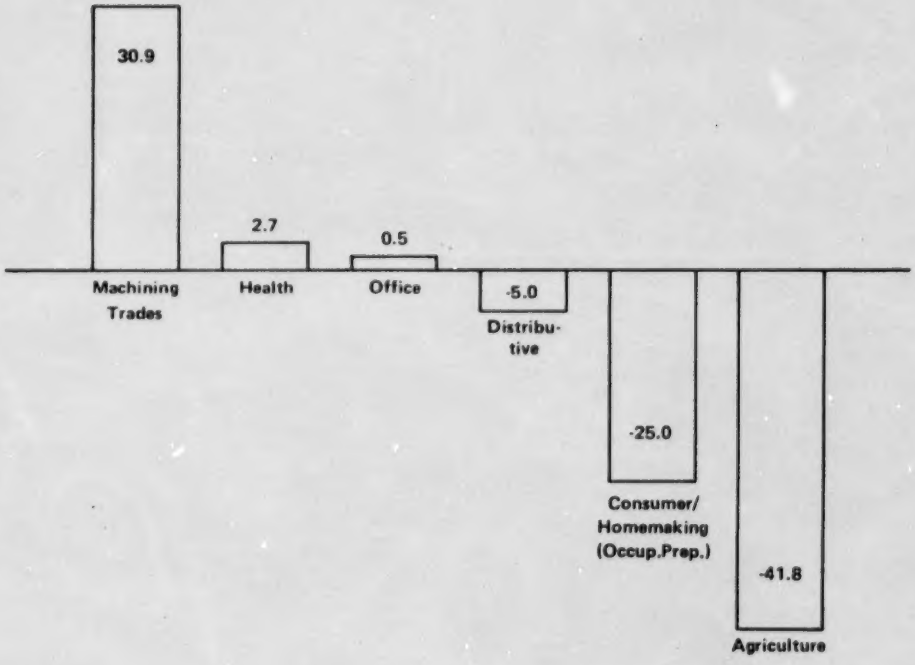

Figure 8. Comparative rates of growth for 1974-1975 -- 1978-1979 in vocational education programs/fields

What is interesting about these statistics is that enrollments in the three programs in the 1970s were at least three times larger than the projected annual growth of employment in the skilled machining trades.* As Rosenthal (1982) points out:

> In the Bureau's three alternative projections of employment to 1990, the average annual growth of employment for skilled machining workers (including numerically controlled machine tool operators and machine tool operators, combo) ranged from 11,900 to 23,200 from 1980 to 1990. (pp. 35-36)

One should not construe this to mean that three times as many persons were being prepared as were needed. After all, only a fraction of the students enrolled end up as program completers; a lesser number seek and find employment in the field for which trained; and an even lesser number remain in these occupations, achieve journey- person status, or go on to obtain the more specialized skills that employers need the most.

Potential Responsiveness to Other Skilled Labor Shortages

If the literature is correct and other skilled industrial occupations have also experienced shortages of workers since the mid-1970s, how has vocational education responded to this condition? To answer this question, eight kinds of occupational training programs were selected for analysis: those to train electrical technicians, electronic technicians, industrial engineering technicians, mechanical engineering technicians, carpenters, electricians, welders, and drafters. One reason for selecting these particular programs is that there is a reasonably close correspondance between occupational titles listed in the U.S. Bureau of Labor Statistics' 1978 to 1990 estimates of employment in the technical and craft occupations (Carey 1981), and these vocational education instructional program titles. The Bureau of Labor Statistics combines electrical and electronic technicians to create one occupational title and does the same for industrial and mechanical engineering technicians. Comparisons between training program enrollments and estimates of employment opportunities in these occupations are reported in table 3.

The data reported in table 3 indicate that if postsecondary enrollments and secondary and postsecondary completions remain essentially stable for the period 1978-1990, as they did for the school years 1974-75 through 1978-79, then--

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*If secondary students are included, the average number of completions in the three programs was 31,276 for school years 1974-75 through 1977-78 and completions increased by 43 percent during this period of time.

- o both enrollments and completions will be greater than the number of jobs created by growth in employment for electrical/electronic technicians, carpenters, welder/flamecutters, and drafters;

- o enrollments will be greater than the number of jobs created by growth in employment for electricians; and there will be only slightly fewer program completions than the number of job openings due to growth in employment for electricians; and

- o enrollments will exceed the number of jobs created by growth in employment for industrial and mechanical engineering technicians; and completions from vocational education programs will represent about 60 percent of the job openings created by occupational growth.

If the enrollments in the eight vocational programs continue at the same rates of growth for the period 1978-1990 as they did for the school years 1974-75 through 1978-79, then it is reasonable to expect that local level vocational education might even be overresponding (in terms of training capacity and potential number of persons available for employment) to the occupational projections developed for the 1978-1990 time frame. To depend, however, on only vocational education enrollment and completion data for estimating the supply of skilled workers in particular occupations would be inadvisable for vocational education planners. After all, a significant proportion of this country's skilled craftsworkers "pick up" their trade through informal means (Hills 1982). Other sources of supply are those workers who have received their training through the military, employee training programs, private schools, and correspondence schools. If one considers these other sources of supply, then perhaps vocational education is doing at least its share in responding to shortages of skilled machining trades workers. In any event, the fact that multiple sources of supply typically exist makes it imperative that vocational education planners be very cautious in interpreting published and unpublished information about shortages of skilled labor, since the available supply is not always obvious.

This situation is exemplified in the case of computer programmers, an occupation sometimes thought to be experiencing critical national shortages of trained workers. A recent article in Business Week ("Jobs for Programmers" 1982) points out that new jobs for entry-level programmers are beginning to disappear because major sources of supply (i.e., vocational schools, colleges, and universities) are turning out more than twice the estimated demand for entry-level computer programmers. The article does not discuss the supply of entry-level computer programmers from other major sources (e.g., self-taught, military).

TABLE 3

ENROLLMENTS AND COMPLETIONS COMPARED WITH AVERAGE ANNUAL EMPLOYMENT GROWTH

Occupations	Average Annual Postsecondary Enrollment (1974-75--1978-79)	Average Annual Completions (including Secondary)	Average Annual Growth 1978-1990[1]
Electrical/Electronic Technicians	50,262	17,692	16,083
Industrial/Mechanical Engineering Technicians[2]	12,283	1,745	2,917
Carpenters	63,894	40,881	24,583
Electricians	73,867	16,652	17,500
Plumbers/Pipefitters	33,755	7,638	12,583
Welders/Flamecutters	129,890	42,146	17,833
Drafters	54,369	32,387	12,750

[1]Calculated from data reported for High Trend I (Carey 1981, table 2).

[2]Includes chemical, civil, electromechanical, environmental control, industrial, instrumentation, mechanical, and metallurgical technician programs.

New Directions in Responding

Since the mid-1970s, there has been a rapid escalation in efforts by most state vocational education agencies to collaborate with local training providers in implementing programs tailored to the training needs of specific firms and military bases. Some of this customized training prepares persons for semiskilled employment while other training prepares or upgrades skilled workers (Bottoms 1982; Brant 1982; Burdette 1982; U.S. Departments 1982; VocEd 1982). However, the relative emphasis these efforts give to skilled occupational training is not clear.

In the future, state vocational education agencies might want to consider explicitly what should be an appropriate balance between allocating resources for short-term customized training for specific clients, and the longer and more expensive training of skilled workers to meet projected skill shortages.

CHAPTER IV

POLICY IMPLICATIONS

The purpose of this study was to obtain insights into the past responsiveness of the public vocational education system in training industrially oriented skilled craftsworkers and technicians, so that suggestions for even greater responsiveness might be formulated. In conducting this study, it was assumed that the nation will undergo economic recovery and reindustrialization in the 1980s and beyond; that it will most likely experience a growth in defense expenditures; and that these events may be accompanied by marked changes in production technologies, many of which are difficult to forecast with certainty. If these assumptions hold true, the problem of preparing and upgrading industrially oriented skilled craftsworkers and technicians will be a critical one for the country. The findings and assumptions here suggest that state vocational education agencies may profit by examining their present planning emphases on program improvement and program approval, and by considering the desirability of addressing planning for change in accord with the training needs of the 1980s and beyond.

Findings

The major findings of the study can be summarized as follows:

- There is insufficient data to be certain that there will be shortages of skilled industrial workers in the 1980s and beyond. There are logical reasons for supposing that such shortages are likely.

- Information systems are not yet in place that can adequately estimate labor shortages, their extent, or locations.

- Local providers of vocational education have a record of responding to occupational skill shortages that are known to exist or are likely to exist in their service areas.

- There are many examples of short-term customized training programs for industrial craftsworkers and technicians that have been initiated and/or supported by state vocational education agencies. However, few of these agencies have given a visible priority to long term planning and policy formulation to deal with skilled labor shortages.

Implications of the Findings

These findings serve as a basis for suggesting that Congress should consider--

- o providing a framework for state and local vocational education and business and industry groups to create and sustain job training partnership arrangements that will actively involve employers in vocational education planning to meet skilled labor shortages. Local and state advisory councils for vocational education are not a substitute for job training partnership arrangements.

- o encouraging and adequately funding the development of information systems that can forecast (even if imprecisely) occupational skill shortages and surpluses at state, regional, and national levels. The Bureau of Labor Statistics, the National Occupational Information Coordinating Committee and its state counterparts, and state and local vocational education agencies should be involved in achieving this aim.

State boards and agencies for vocational education should consider--

- o formulating the kinds of long-range planning and funding policies that do not shortchange the long-term, expensive training that is required to produce skilled industrial workers who will be adaptable to the occupational skills required in the next decade. There are, for example, conflicts in many states over allocating available funds for supporting secondary and postsecondary vocational education. Given the length of time needed to educate adequately as well as train persons to be craftsworkers or technicians, more attention should be directed to how best to articulate secondary and postsecondary vocational education and not how to divide up available funds between the two deliverers;

- o including data on demographic trends, forecasts of industrial expansion, and analyses of emerging technologies in industrial production in doing program planning to deal with skilled labor shortages.

An Additional Policy Implication

Literature reviewed in the course of the study suggests that the long-standing emphasis in federal legislation on using vocational education to enhance economic opportunities of less academically advantaged groups might conflict with vocational education's need to train persons for skilled occupations requiring high levels of computational and communications skills (National Tooling and Machining Association 1982; Ruff et al. 1981). This philosophical and economic issue has political implications as well, especially in larger urban areas. As a result of declining educational budgets, any expansion of programming that calls for high levels of competence in mathematic and reading skills may be accompanied by a reduction in programming for the less academically advantaged.

Such an occurence may create a polarization among groups that support vocational education. In these circumstances shifts in programming, especially at the secondary level, are likely to be approached cautiously. On the other hand, this potential conflict may focus greater attention on the need to ensure that all students receive adequate basic skills instruction, and on the need to establish better articulation between general and vocational education.

APPENDIX

INSTRUCTIONAL PROGRAM CODES AND TITLES USED IN THE ANALYSES OF VOCATIONAL EDUCATION ENROLLMENTS

INDUSTRIALLY ORIENTED TRADE AND INDUSTRIAL EDUCATION PROGRAMS SELECTED FOR ANALYSIS*

Title	Instructional Code
Aviation Occupations	17.0400
Business Machine Maintenance	17.0600
Carpentry	17.1001
Plumbing and Pipefitting	17.1007
Diesel Mechanics	17.1200
Drafting Occupations	17.1300
Electrical Occupations	17.1400
Electronic Occupations	17.1500
Instrument Maintenance and Repair	17.2100
Machine Shop	17.2302
Machine Tool Operations	17.2303
Sheet Metal	17.2305
Welding and Cutting	17.2306
Tool and Die Making	17.2307

*This appendix contains U.S. Department of Education Instructional codes and titles that were used to report enrollment data for trade and industrial and technical education programs.

INDUSTRIALLY ORIENTED TECHNICAL EDUCATION
PROGRAMS SELECTED FOR ANALYSIS

Title	Instructional Code
Aeronautical Technology	16.0101
Architectural Technology	16.0103
Chemical Technology	16.0105
Civil Technology	16.0106
Electrical Technology	16.0107
Electronic Technology	16.0108
Electromechanical Technology	16.0109
Environmental Control Technology	16.0110
Industrial Technology	16.0111
Instrumentation Technology	16.0112
Mechanical Technology	16.0113
Metallurgical Technology	16.0114
Scientific Data Technology	16.0117

NONINDUSTRIALLY ORIENTED TRADE AND INDUSTRIAL EDUCATION PROGRAMS SELECTED FOR ANALYSIS

Title	Instructional Code
Air Conditioning	17.0100
Appliance Repair	17.0200
Body and Fender Repair	17.0301
Auto Mechanics	17.0302
Other Automotive	17.0399
Blueprint Reading	17.0500
Commercial Art Occupations	17.0700
Commercial Fishery Occupations	17.0800
Commercial Photography	17.0900
Electricity	17.1002
Masonry	17.1004
Other Construction and Maintenance	17.1099
Custodial Services	17.1101
Fabric Maintenance Services	17.1600
Management Development	17.1700
Graphic Arts Occupations	17.1900
Maritime Occupations	17.2200
Other Metalworking Occupations	17.2399
Barbering	17.2601
Cosmetology	17.2602

(continued)

(continued)

Title	Instructional Code
Other Personal Services	17.2699
Plastics Occupations	17.2700
Firefighter Training	17.2801
Law Enforcement Training	17.2802
Other Public Services	17.2899
Quantity Food Occupations	17.2900
Refrigeration	17.3000
Small Engine Repair	17.3100
Stationary Energy Occupations	17.3200
Textile Products and Fabrics	17.3300
Leather Working	17.3400
Upholstering	17.3500
Woodworking Occupations	17.3600
Other	17.9900

NONINDUSTRIALLY ORIENTED TECHNICAL EDUCATION
PROGRAMS SELECTED FOR ANALYSIS

Title	Instructional Code
Automotive Technology	16.0104
Commercial Pilot Training	16.0601
Fire and Fire Safety Technology	16.0602
Forestry Technology	16.0603
Oceanographic Technology	16.0604
Police Science	16.0605
Air Pollution Technology	16.9901
Water and Waste Water Technology	16.9902
Other	16.9900

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